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ABSTRACT

A pilot study was conducted to determine effective methods for testing students' learning processes. The theoretical framework within which learning processes were investigated is based on the B-P-E paradigm. This states that "Behavior (B) is a function of the Person (P) and the Environment (E)". After reviewing research done in related areas, the research project attempted to determine the instructional strategies (E) that are best for pupils having different cognitive styles and strategies (P) in the achievement of different objectives (B). Subjects were eighth grade students. Students' conceptual levels (cognitive complexity and maturity) were measured by means of PCM (Paragraph Completion Method). Their cognitive styles were measured by means of GEFT (Group Embedded Figures Test), which required them to find and trace the outlines of progressively complex geometric forms. Both the PCM and the GEFT were found to be generally reliable test instruments. A discussion is offered of the value of and problems with these tests in accurately assessing the learning processes of students. Appendices include references and tabular presentations of the test results. (JD)

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Anna-Liisa Leino

**LEARNING PROCESS IN TERMS OF
STYLES AND STRATEGIES: THEORETICAL
BACKGROUND AND PILOT STUDY**

SP 017 735

RESEARCH BULLETIN

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LEARNING PROCESS IN TERMS OF STYLES AND STRATEGIES:
THEORETICAL BACKGROUND AND PILOT STUDY

Helsinki 1980

Preface

I wish to express my sincerest gratitude to Professor David E. Hunt, whose visit to Helsinki University in May 1980 was the highlight of the whole academic year. The inspiring lectures he delivered, informative seminars he conducted and the discussions we had on formal as well as informal occasions were very valuable to all of us. I also owe a special debt of gratitude to him for having kept me well-informed about his research ever since I first wrote to him a few years ago.

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I appreciate the inclusion of this study in the Research Bulletin series of the Institute of Education.

October 1980
Anna-Liisa Leino

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1. Introduction

The most central element in the teaching-learning process is the individual learner. The teacher should adjust his teaching in terms of the learner. There is not, however, enough information available about those learner characteristics in terms of which teaching could be adjusted. In this article a tentative attempt is made to lay a foundation for gathering relevant information.

Concerning student characteristics the following observation based on Kluckhohn and Murray (Hunt 1979,22) is interesting:

"Every student is

1. Like all other students in some ways
2. Like some other students in some ways, and
3. Like no other student in some ways."

Of the cases above the first quite obviously concerns basic physiological traits as well as physical and psychological needs, which all people have in common. In the traditional teacher-centered way of teaching the assumption seems to have been made that all students are similar in every respect.

The second case represents a situation which gives attention to differences between pupils. Characteristics that have been widely investigated are intelligence (consisting of various aptitude factors), personality (different temperamental traits) and motivation (including attitude and interest variables). These investigations, however, seldom yielded such concrete results as could have been used as a basis for instructional adaptation. Studies of the relationship between intelligence and school achievements, for example, led to discussions concerning the desirability of ability grouping. The high correlation coefficients did, in fact, prove that the teacher had adjusted his teaching in terms of the intelligence of his pupils. The concept of intelligence is, however, so value-laden that it can hardly guide instructional planning in

our present democratic school system. Now that we are faced with problems brought about by changes in our society in general and in our educational system in particular new approaches are needed for implementing the aims and objectives of education. Information on the learning process of students would seem to offer a sound basis for instructional planning and adaptation. Learning process is a difficult field of study and a fairly new one in Finland. We will make an attempt to study it in terms of styles and strategies.

In spite of the fact that one has to be realistic and acknowledge the fact that students in an educational system will always mainly have to be taught in groups, case number three cannot be neglected. If the teacher teaches the average student he misses almost everyone in class to varying extent. Looking for completely idiosyncratic features (e.g. by means of case studies) is important, too, for occasional individualization. On the other hand, it is self-evident that teaching can never be completely individualized, nor would it, in fact, be desirable, since everyone in modern society must have at least some ability to act as a member of a group.

2. Theoretical Framework

The general theoretical framework within which learning process will be investigated is Hunt's B - P - E paradigm. It is based on Kurt Lewin's classic statement "Behavior (B) is a function of the Person (P) and the Environment (E)." In education it means that the achievement of an educational objective is dependent upon the effect of the educational approach on the individual learner (Hunt 1971, 34; Hunt et al. 1974a, 4; Hunt 1975). An example of the B - P - E paradigm is Conceptual Level Matching Model developed by Hunt.

The model is originally based on a theory of personality development (Harvey et al. 1961). The basic unit is the conceptual system which has been defined as a "schema that provides the basis by which the

individual relates to the environmental events he experiences" (Harvey et al.1961,224).Later developments of the theory speak of the Conceptual Level (CL), which is a person characteristic referring to both cognitive complexity (differentiation and integration) and interpersonal maturity (increasing self-responsibility) (Hunt 1975,218). It is concerned with individual differences in information processing, the way a person "reads" environmental events (Hunt 1971,18). People differ in terms of their ability to differentiate and combine stimuli. They also differ in terms of the way they conceptualize the relationship between themselves and others. "Systems vary from a form in which both self and others are parts of the generalized standard, to a structure in which the self is part of a highly differentiated others, all of which are integrated into a whole" (Hunt 1971,18). Students high on CL are more flexible, creative and tolerant of stress than those low on it.

The other person characteristics that have been included into the model are motivational orientation, value orientation, and sensory orientation. These descriptions have been called "accessibility characteristics" since they are translatable into optimal educational environments for the student's learning and development. They indicate his susceptibility to different environmental circumstances (Hunt 1971,1975; Hunt et al. 1974 a,b).

In Conceptual Level Matching Model the dimension of educational environment that has been matched with Conceptual Level is the degree of structure (or the degree of organisation) provided by the educational approach. In high structured environments the teacher is responsible for learning activities, the instructions and expectations are very specific and materials are carefully pre-organised. In low structured environments, on the other hand, the activities are very likely to be determined by students, the instructions and expectations are of a general nature and the materials not preorganised (Hunt 1979). Research results indicate that low CL learners profit more from a high structured environment and high CL learners more from a low structure or are less

affected by variations in structure (Hunt 1971,44; Hunt 1977; McLachlan et al.1973; Tomlinson 1971). It is interesting to note that the sixteen models of teaching described by Joyce et al. (1972; see also Joyce et al.1973) have been described in terms of their degree of structure and task complexity (Hunt et al. 1974b).

A central element in the model is behavior (B), the educational objective(s), in relation to which matching statements have to be made. Hunt (1975) has emphasized the distinction between contemporaneous matching and developmental matching. The main purpose of the former is to foster immediate learning while the latter is concerned with enhancing pupil growth, in which case the person characteristic is itself the object of modification (Hunt 1979).

The importance of Hunt's theory for education has been widely recognized (e.g. Brophy et al.1974,269; Goldstein 1978,136). It was chosen as the framework of the study because it is dynamic in nature with its emphasis on person-environment interaction. Information on this interaction is important since it forms the basis of the teacher's adjustment in terms of the learners. The dynamic nature of the theory is seen in its emphasis on student growth and the constant need of the teacher to adjust to this change, to "read" and "flex" to students (see Hunt 1976).

Behavior-person-environment interaction has often been defined as ATI (Aptitude-Treatment-Interaction) or TTI (Trait-Treatment-Interaction). These definitions, however, regard person-environment interaction from a narrow viewpoint. The main emphasis is on statistical and methodological issues at the expense of conceptual and theoretical ones. The developmental aspect is neglected and the environment supposed to be a static one (Hunt 1975,1979;Lewis1976;Rothkopf1978).Snow (1976) has given attention to the narrowness of the term "aptitude" and wants to widen its scope to include any aspect of an individual that predicts response to instruction, e.g. personality and stylistic character-

istics. The term suggested by Glaser (Hunt 1979,9) to such educationally relevant characteristics is "the new aptitudes".

2.1 Further Specification of the Framework

In the following an attempt will be made at further specification of P by means of other dimensions of cognitive style that could serve as accessibility characteristics themselves or yield accessibility information. Cognitive styles have been studied in the laboratories of psychology for about a quarter of a century (see e.g. Cross 1976; Mahlios 1978; Nelson 1977). They have not, however, been investigated in terms of their implications for educational problems (Witkin 1976), with the exception of Conceptual Level. Consequently, in spite of a long research tradition, need for further research is quite obvious (see e.g. Mikkonen 1978,42). Lab experimentation lacks the ecological validity that would be necessary for the results to be applicable to classroom situations. Knowledge available from the classrooms is limited and spotty (e.g. Brophy et al.1974,242). It is in fact only recently that people in education have become aware of the research that has been done in the field of cognitive styles in psychology (e.g. Hosenfeld 1975,143), and the possibilities of applying such information to educational theory and practice have been widely recognized (e.g. Cross 1976; Heidt 1978; Messick 1972; Sigel et al. 1974; Witkin 1976).

Cognitive style can be defined as the pupil's preferred way of selecting acquiring, and processing information. It represents the student's typical mode of perceiving, thinking, remembering and problem solving (e.g. Cronbach et al.1977,375; Heidt 1978; Messick 1976; Nunney 1977; Sigel et al.1974,251;Thornell 1976,502). Pask et.(1975) use the term cognitive competence.

2.1.1 Cognitive Styles Versus Abilities

Messick (1976,7-11) has compared cognitive styles with abilities. According to him, abilities refer to the content of cognition, to what information is processed by what operations in what form. Cognitive styles, on the other hand, concern the question of how the behavior occurs - the manner in which information is processed. As for the measurement of abilities and styles the former center around maximal performance while the latter around typical performance. Abilities are unipolar, which makes them value-directional: it is better to have more ability than less. Cognitive styles are bipolar with each end of the dimension having a different impact upon cognitive functioning. The value of each pole depends on the situation and the task at hand. Abilities are limited in range, they are usually specific to particular areas of content, while cognitive styles are pervasive dimensions. They cut across boundaries traditionally used in compartmentalizing the human psyche and so help to restore the psyche to its proper status of a holistic entity" (Witkin et al. 1977, 15). According to Royce (Messick 1976, 6), if abilities, temperament traits, and affective abilities are first and second order factors, then cognitive styles are higher order factors linking these domains. There are also differences in the research background of abilities and styles. In spite of the differences, it is to be remembered that there are varying degrees of overlap between particular abilities and styles. - The following table is a summary of the above:

Abilities	Cognitive Styles
- what, content - maximal performance - unipolar - limited in scope - background: mental test theory	- how, process - typical performance - value differentiated - cut across domains - background: study of perception & personality
varying degrees of overlap in terms of conception and measurement	

(based on Messick 1976,7-11)

2.1.2 Dimensions of Cognitive Style

In the following, dimensions of cognitive style, most frequently encountered in the literature of educational relevance, will be dealt with briefly. The list of dimensions has no pretense of being exhaustive. The references resorted to are in many cases secondary ones, which is considered acceptable on two accounts. First of all, the purpose here is only to give a rough idea of how component P could be further specified. Consequently the dimensions serve as examples of tentative specification. Secondly, the amount of information accumulated during the past quarter of a century in psychology is so enormous that surveying it would occupy one person for years to come. Besides, there is a factor-analytic study in progress which includes all the cognitive styles on record at the time it was started (Witkin 1976). The results of this study are, however, not yet available (Messick, December 1979, personal communication). The most thorough references to the original sources are to be found in Messick (1976).

Sensory modality preferences "refer to individual consistencies in relative reliance upon different sensory modalities for experiencing the world" (Messick 1976, 21). The most important modalities are kinesthetic, visual, and auditory, referred to as enactive, ikonic, and symbolic by Bruner et al. (1966). In the development of an individual a shift occurs from heavy reliance on the kinesthetic modality to a later preference for the visual and finally for the auditory or verbal modality. The individual also becomes more capable to integrate information obtained through different modalities. According to Messick (1976), individuals differ markedly in their reliance upon one or another of these modalities, a conclusion not shared by Heidt (1978, 115). The dimension obviously has great educational relevance; it is reported, e.g., that seventy to eighty percent of youths in juvenile detention facilities in the USA are auditory learners (Recking 1979). On the other hand, it has been found difficult to classify subjects reliably in terms of auditory-visual preference scores (DeBoth et al. 1978). Kennedy et al. (1978) suggest that auditory cognitive style should be investigated for relationship with reading ability, in particular.

Field independence/field dependence is one of the most extensively investigated cognitive styles, which refers to an analytical-

global dimension. The field independent person has a tendency to perceive items as discrete from the field when the field is structured. When the field has little inherent structure of its own, he tends to give it a structure. The field dependent person, on the other hand, experiences parts of the field as embedded in the background. He perceives the whole field globally in an undifferentiated and unstructured manner. The dimension has been found to extend across tasks involving auditory and tactile modalities in addition to visual. The development and determinants of this dimension have been thoroughly investigated as well as its relationship to social skills and academic career choice and achievements (e.g. Witkin 1975, 1976; Witkin et al. 1977).

Styles of categorization. All cognitive activity, for example concept attainment, is dependent on categorization (Bruner et al. 1962). A central dimension in concept formation is scanning-focusing (Bruner et al. 1962), which dimension has also been isolated by Gardner and co-workers (Shouksmith 1970). Scanning has been defined as a dimension of individual differences in the extensiveness and intensity of attention deployment (Messick 1976). Heidt (1978) calls scanning a kind of game of hazard strategy where falsification of a hypothesis leads to the formation of a new one, which is unconnected with the former. A focusing individual, on the other hand, keeps all the possible hypotheses in mind and gradually eliminates the ones that have been falsified. Breadth of categorization concerns consistent individual preferences for broad inclusiveness as opposed to narrow exclusiveness (Messick 1976). A broad categorizer forms a small number of categories in which he includes a great number of cases while a narrow categorizer forms a great number of categories with few cases in them. The Kagan group (Sigel et al 1974) have suggested a distinction between descriptive-analytic, relational-contextual, and inferential-categorical modes of perceiving and categorizing. The first refers to the tendency to classify items on the basis of observable characteristics that are part of the stimulus situation. In the second the items are grouped together on the basis of functional, temporal or spatial proximity. The third reflects the tendency to form categories on the basis of inferences made about the items that are grouped together. It was noticed that people varied in their tempo, or the time it took them to give a response, which led to the development of the following dimension.

Reflexivity-impulsivity refers to individual consistencies in the speed of information selection and processing. An impulsive learner tends to offer the first answer even though it is often incorrect, while a reflexive subject tries to consider all possibilities before deciding (Cross 1976; Heidt 1978; Messick 1976).

Levelling-sharpening concerns individual variations in assimilating new material in memory. It represents the degree to which an

individual merges new stimuli with older ones in his memory. A leveller tends to mix similar memories while a sharpener is less prone to do so. He may even consider the new stimuli to be less similar than is in fact the case (Cross 1976; Heidt 1978; Messick 1976).

Wholist-serialist. A serialist learns and remembers information by collecting small details and forms an overall view on the basis of this collection. A wholist, on the other hand, learns and remembers by obtaining a survey of the new field before turning to details. The main difference between these two types concerns the way new material is attached to old. A serialist works at the same level of details as with the old material, whereas a wholist is able to differentiate the main points and attach them in a meaningful way to what he already knows. An irredundant wholist's survey contains only relevant and essential items, while a redundant wholist's overview includes also logically irrelevant items, which are, nevertheless, psychologically important since they help him to learn whatever was originally to be learned. Research on this dimension has, to a great extent, been concerned with science learning (Pask et al. 1975).

Constricted-flexible control refers to individual differences in susceptibility to distraction and cognitive interference. It involves the extent to which an individual restricts attention to relevant cues and actively inhibits competing learned responses (Messick 1976).

Rigidity-flexibility is a dimension of individual differences in the learner's readiness to change his tentative solution to a specific problem. Rigidity means difficulty to change one's own attitude (Heidt 1978).

Shouksmith (1970) speaks of restricted and open style. He has obtained his measure by means of the semantic differential technique. A person who restricts his check marks to the middle of the scale is said to be restricted while a person who scatters his marks widely placing the majority at either extreme is open. A response set is thus considered to be an indicator of the person's cognitive styles.

Messick (1976) has also listed and given a brief description of the following styles: field articulation, conceptual differentiation, risk taking versus cautiousness, tolerance for unrealistic experience and strong versus weak automatization.

2.1.3 Summary of Cognitive Styles

Since it is typical of the studies of cognitive styles that each has been taken up in isolation by different groups of researchers, there is as yet very little specific information available on the overlap and interrelationships among the variables. Some assumptions have, however, been made on the interrelationships among some of these variables (see Shouksmith 1970, 90-91). Kogan (1976) has critically summarized a mass of empirical researches on field independence/dependence, breadth of categorization and styles of conceptualization in infancy and early childhood. He states (p.120) that "it is not possible to go much beyond the truism that the classes of cognitive style under review are neither completely independent nor completely overlapping in their interrelationships".

Another typical feature is that researchers use the same term "cognitive style" but it means different things to them: the criterion measures as well as the problems have been different (e.g. Cronbach et al. 1977; Sigel et al. 1974). Another term that is widely used is learning style. According to Cross (1976, 113) cognitive style is usually reserved for those dimensions that are based on experimental studies of cognitive functioning, while most people using other approaches use learning style (or learning modality). This evidently is not true of all the cases, since, for example, Krashen's (e.g. 1976) monitoring (=the individual's use of his consciously learned linguistic knowledge to alter his performance in the second language under certain circumstances) has been classified as a cognitive style by Schuman (1978). In Sperry's (1972, 24) opinion, however, cognitive style and learning style have been used synonymously in the literature, although cognitive style seems to be more common. Keefe (1979) makes a clear distinction between cognitive style and learning style. He considers learning style a broader term, which includes cognitive, affective, and physiological styles. He further divides cognitive styles into reception styles and conception formation and retention styles. Similarly he divides affective styles into attention

styles and expectancy and incentive styles. It seems that this kind of sharp distinction does not get support from relevant literature (see e.g. Messick 1976).

Messick (1976) has drawn a distinction between cognitive styles and cognitive strategies, which is based on Bruner (1956) and Shouk-smith (1970). He defines cognitive styles as "high level heuristics that organize and control behavior across a wide variety of situations", while cognitive strategies "are decision-making regularities in information processing that at least in part are a function of the conditions of particular situations" (p.6). Pask (1976) has drawn a similar distinction between learning styles and learning strategies. Learning styles are relatively stable ways of learning while learning strategies are responses to the requirements of a particular task. Entwistle (1979) has asked whether it is possible to speak of a characteristic learning style at all. He wonders whether the term style should actually be dropped since it only comes out as the response to specific tasks. This view is supported by the results of a research pointing to the interaction of cognitive style and problem type (Rollins et al. 1977).

The question of the developmental aspect of cognitive styles is an interesting one. They are generally considered to be rather stable and permanent but not completely unchangeable (e.g. Cross 1976; Nelson 1977). Hunt has in many connections (most recently 1979) emphasized the importance of the developmental aspect for education. This can be problematic since many of the cognitive styles are obviously not value directional like the Conceptual Level. The aim of education undoubtedly is to enhance the student's growth towards higher levels of conceptual development and interpersonal maturity. On the other hand, it would be difficult to decide whether development towards greater field-independence, for example, should be encouraged since on one occasion it may be good to be field-independent while on another field-dependent. The same concerns reflexivity-impulsivity, even though suggestions have been made that children should be trained to be more

reflective (see e.g. Campbell et al 1972). Reflective children have been considered to be better learners, and still, it has been found out that impulsive children are better at solving certain kinds of problems (Rollins et al. 1977).

Since the field of cognitive styles or learning styles is very heterogeneous as a whole, it is no wonder that a whole "panoply" of scales and instruments have been developed to measure individual differences after people in education became aware of the research that had been done in psychology. In the following we will give a brief review of some of the instruments and also consider other means of acquiring information. Hunt's instrument is used in the pilot study and described in the empirical part. The same is true of the other instruments that are used.

2.1.4 Acquiring Information of Learning Styles.

In addition to scales and instruments developed for the purpose, information can also be acquired by means of interviews , observations of learning situations and also through the analysis of the subject's use of his native language.

The following four scales and instruments have received a great deal of attention in the literature:

Learning Style Inventory (Dunn et al. 1977, 1978; Price et al. 1976; see also Lepke 1977) focuses on environmental (sound, light, temperature, and design), emotional (motivation, persistence, responsibility, and structure), sociological (peers, self, pair, team, adult and varied), and physical (perceptual preferences, food intake, time of day, and mobility) needs and their interdependence in determining individual learning styles. The inventory consists of a hundred statements with which the learner agrees or disagrees. The analysis of the inventory is computerized providing the teacher with a summary of each student's preferred learning style and information on the reliability of the results. Review of literature was made use of in developing the instrument (Price et al. 1976). More specific information on the theoretical background or the literature is not, however, given in the sources available. Thus the relationship with studies on cognitive styles

e.g. is unclear. In one of their latest articles, however, the writers (Dunn et al. 1979) show their awareness of psychological research on cognitive styles and they seem to have added a fifth dimension to their inventory. The dimension called psychological consists of the following cognitive styles: analytical/global, field dependent/independent and reflective/impulsive.

Papalia's Learning Modalities Inventory (Papalia 1976; Lepke 1977, 1978) is also designed to measure learning preferences. It consists of twenty-eight affirmative statements to which the student responds on a five-point scale indicating his acceptance of each statement. The inventory is narrower in scope than the one developed by Dunn et al., but there seems to be some overlap. Individual Differences Inventory is offered for observing students' classroom behaviors. The teacher assesses, on a five-point scale, his students' behaviors on the following dimensions: Cognitive styles, Sensory modes, Interactive learning modes, Work habits, Personal characteristics, Intellectual dependence, Intellectual independence and Originality. Interviews are recommended for cases where there are discrepancies between the student's self-assessment and the teachers' assessment of his behavior. The instrument is based on Spanish teachers' descriptions of students' behaviors in their secondary school language classroom (Papalia 1978).

Cognitive Preference Inventory (Harper 1975; Lepke 1977, 1978; Nunney 1977; Pflieger et al. 1977; Woolson, date not given) developed by Hill consists of four interacting parts: Symbolic orientations analyse the learner's cognitive patterns in response to theoretical (linguistic and quantitative) symbols and qualitative (sensory, programmatic and cultural codes) symbols. Cultural determinants (individuality, associates, family) determine the meaning of symbols. Modalities of inference indicate the form of inference an individual uses. Memory concern includes e.g. the functioning of memory. The analysis of the instrument is computerized providing the teacher with the learner's cognitive style map, which gives elaborate information of the way the learner seeks meaning from his environment and experience. The use of the inventory seems very complicated; in order to be able to interpret the results one will have to learn the symbolic system indicating the learning profiles, the maximum amount of which is over two and a half thousand. An interesting point is that the instrument makes an attempt to gather information on all the five senses through which an individual can acquire meaning: hearing (auditory), taste (savory), touch (tactile), smell (olfactory), and sight (visual). The instrument was originally developed for use in a community college but it has also been adapted for younger learners (Woolson, date not given) and used as a research tool (Kuchinskas 1979). As can be seen, the above is based on secondary sources; thus there is a lack of important background information used in the development of the inventory.

Reinert (1976,1977; Lepke 1978) has developed an instrument called ELSIE (Edmonds Learning Style Identification Exercise). It is based on the assumption that the learner's pattern of internalization of his native language reveals his learning style. ELSIE gives a profile of an individual's learning style according to the way the learners respond when they hear spoken native language words. The response may be visualization (in hearing a given word a person will have a mental image of what he heard), written word (he will have a mental image of the word spelled out), or listening (he will have no mental image but will receive the meaning from hearing only the sound of the word). Finally it can also be a fleeting kinesthetic reaction (emotional or physical). The sources do not reveal the theoretical background to this instrument. It could naturally be traced back to Bruner et al. (1966) or studies on sensory modality preferences.

Most of the instruments above attempt to gather information on students' learning preferences with the assumption often being that students learn better when they are taught the way they prefer (e.g. Price 1978,389). There is,however, often a distinct discrepancy between the student's requirements and his preferences. (Hunt 1975;Messick 1976). In an interesting experiment it was discovered that with field-independent and field-dependent students a non-preferred study technique resulted in better performance (Annis et al.1978). There is also a gap between what the behavior of younger school children really is and what they think it is (Fischer et al.1979),which makes the use of most of the above instruments rather difficult with younger children. They, however, represent attempts at obtaining objective information on learning styles.

Information can also be obtained through observation and interview techniques. The use of the former is, however, still at an experimental stage. Naiman et al. (1978) observed individual language learners over a prolonged period of time in order to be able to isolate specific techniques and strategies used by good and poor learners. Their approach was not successful in the sense that it did not differentiate between pupils. In addition they questioned the validity of an approach in which process is inferred on the basis of linguistic behavior such as it is observed by an outsider. It is quite obvious that observation techniques connected with interviews yield more information than mere observation alone.

The interviews conducted by Naiman et al. revealed that several students had used such techniques for learning which were invisible to observation, e.g. answering silently every question asked by the teacher. Hosenfeld's (1975,1976,1977) purpose was to identify learning strategies of foreign language learners at college and high school level. She used interviews involving student self-observation and "thinking aloud" as they performed tasks given to them. She found that the students were capable of observing and describing how they completed foreign language tasks. On the other hand, however, there was a discrepancy between what the teachers thought the students were doing and what they actually were doing. A case study through interview and observation techniques showed the value of such techniques in helping the individual learner with her specific language problems.(Hosenfeld 1979). Similar techniques have also been used by Leino,J.(1978) in a study concerning mathematical thinking and performance processes. Students "thought aloud" and described the way they approached mathematical problems. These techniques were found valuable in getting information on problem solving styles and strategies. Wright et al.(1979) did not find interview very useful in their research, which may have been due to the fact that it was evidently not connected with the task-performing situation itself. (see also ch.3)

An analysis of the student's use of his native language is also considered to yield information on learning styles. The idea is not a new one but has recently become more prominent. Bandler et al.(1975) point out that people use language in two ways. They use, it first of all, to represent their experiences (reasoning, thinking, fantasizing, rehearsing etc.). When they use language as representational system they create a model of their experiences. This model is based upon their perceptions of the world. Their perceptions can partially be determined by their representations. Secondly, people use language to communicate (talking, discussing, writing, singing etc.) their representations of the world to others. People store their experiences into their representational system in close association with sensory input channels. Based on these ideas Pflieger et al.(1977) have made a tentative

attempt to study the language individuals use to determine which representational system a particular individual prefers to use. They claim that the frequency with which an individual uses nouns, verbs, and adjectives has been shown to be related with particular personality characteristics. Hosenfeld (1977, 1979) also emphasizes the importance of an analysis of an individual's use of his native language in determining his learning style. The study of the use of the mother tongue has, naturally, long linguistic research traditions. It seems, however, that research with the aim of discovering learning styles is only just beginning.

3. Pilot Study

3.1 Pilot Study within the Framework of the Whole Project

The purpose of the whole research project is to study learning process in terms of styles and strategies within the B - P - E-model. The term cognitive will be avoided because it is very often used to refer to cognition only, thus implicating a sharp division between cognitive and affective variables. This is, however, not justified since cognitive styles are deeply involved in affective, emotional, and motivational factors (e.g. Messick 1976). As for the terms style and strategy, they will both be used. It might not be quite justified to give up the term style since it is so firmly rooted in psychological literature and psychological measures of styles will be used. Strategy is considered to be an individual's (often intuitive) combination of styles such as it appears in a learning situation. The term strategy also carries the idea that the behavior of the pupil reflects the nature of the situation and the requirements of the task. (see also ch.2.1.3).

The general, as yet unspecified, problem of the project is: what kind of person/environment match produces the best results in learning?, or stated in other words: what kind of instructional strategies (E) are best for pupils having different styles and and strategies (P) in the achievement of different objectives (B)? An attempt will be made to cover the learning of several different school subjects. On the other hand, this aim may prove far too ambitious; in reality one may , in several cases, have to limit oneself within the study of learning for one or two objectives within a single school subject. Work concerning some subjects is about to begin. The general design of the project looks like the following:

Desing of the Project.

B	P	E	B
Objectives	Learning process: styles, strategies	Instructional strategies	Achievement of objectives
x	x	x	x
⋮	⋮	⋮	⋮
n	n	n	n

What is then the purpose of the pilot study within the whole project? It is to make an attempt to specify component P by means of different styles in order to lay foundation for empirical research. This means looking for suitable, already existing instruments and trying them out on a **Finnish population**, or, in case of lack of proper instruments, developing them and trying them out.

The choice of the styles to be measured will be based on the foregoing theoretical part and the following review of related research. The review mainly consists of studies carried out in other countries since this field of study is fairly new in Finland and has, as yet, interested only very few researchers, as was mentioned earlier. The review is far from exhaustive; it consists of research that has been available to the writer.

3.2 Review of Related Research

Previous research has, first of all, been concerned with the situations in which the subjects have been given different tasks and the learning process (styles and strategies) has been inferred on the basis of their answers. Secondly there are studies which have sought interactions between styles and some aspect(s) of the educational environment. Finally there are a number of studies which mainly yield (correlational) information about the relationships between relevant variables. Each of these groups of studies will be reviewed in the following. (see also ch.2.1.4).

1. The first type of research is exemplified by the pioneering work of the Gothenburg group (e.g. Marton et al. 1976 a,b). The subjects in their studies were paid, voluntary university students who were invited each individually to study passages of academic text. They were to study them the way they normally would, but were told that questions would be asked afterwards. When they had finished reading they were interviewed to find out what they had learned and how they had approached the task. The conversations were tape-recorded, transcribed and analysed. The researchers emphasize that instead of measuring learning quantitatively it should be evaluated qualitatively, in terms of its content. They identified a number of categories containing different conceptions of the content of the learning task. The corresponding differences in the level of processing were described in terms of surface-level and deep-level processing. They also verified the previous findings that students adapt their way of learning to the expectations of what is required of them. The researchers did not have a theoretical framework in terms of which they could have analysed the data. They studied the responses, intuitively looking for consistencies occurring in them. Entwistle et al. (1979) who reviewed the work done by the group pointed out to the time-consumingness of their method and the fact that only small samples can be used. They have made an attempt to develop a questionnaire variant of Marton's procedure. The studies are still in progress.

Wright et al. (1979) gave senior secondary school students a text of biology and history to study after which they were given different written tasks concerning the texts. The answers were analysed in terms of two different strategy dimensions, which were called holist-meristic (atomistic) and transforming-reproductive. The selection of the dimensions was based on previous studies and a pilot study. The researchers found that the student's answers could quite reliably be categorized in terms of these dimensions. This study is also still in progress.

2. Of the studies in which interactions are sought the most numerous seem to concern field-independence/field-dependence and the learning of different school subjects, very often mathematics. Thornell (1977) studied the relationship between the analytic/global (field-independent/dependent) dimension of cognitive style and two strategies of teaching concepts of mathematical symmetry. The strategies varied in the degree of written guidance given to the learners. Results showed no significant differences between the two instructional treatments for subjects with the same cognitive style. Comparison of subjects with dissimilar cognitive styles, however, indicated superior performance by analytic subjects regardless of the instructional strategy used. McLeod et al. (1978) found that field-independent students excelled in treatments that provided minimal guidance and maximal chance for discovery whereas field-dependent students performed best in expository treatments that provided a great deal of structure. Results of subsequent studies have either verified this finding (MacLeod et al. 1979a) or been somewhat contradictory (1979b; 1980a,b).

Concerning geography Grieve et al. (1971) found that extreme global males receiving expository (generalization to be learned as the initial step of the instructional sequence) instruction had significant difficulty in applying knowledge to new situations.

Satterley et al. (1979) studied the interaction of field-independence and the use of advance organizer in learning native language. They found that field-dependent subjects were helped by the use of advance organizers but only in cases where the teacher emphasized its organizing properties during the lesson.

Grippin et al. (1977) examined the interaction of field-dependence independence, dogmatism and programmed Russian vocabulary learning under varying prompt conditions. They found that the mean criterion scores of field-independent and open-minded subjects were higher than those of field-dependent and closed-minded subjects. The hypothesis that closed-minded and field-dependent subjects would benefit from strong prompt conditions was not verified.

3. Denney (1974) compared good and poor readers from grades 2 to 5 on conceptual style preferences, cognitive tempos and attentional styles. Conceptual style differences failed to distinguish between poor and good readers in all but one cases and conceptual tempo in all the cases. Substantial differences between good and poor readers were found along the attentional styles dimension, which contradicted the results of a previous study. The researcher mentions as a potential source of confounding the fact that poor readers were receiving special instruction and were identified as poor readers to themselves and peers. According to him, this difference between the groups may have been moderated by special training or amplified by the stigma attached to poor readers.

Satterley (1979) carried out a factor-analytic study of measures of personality, cognitive styles and achievements in mathematics, geography and native language. Factors of general ability, field-independence and levelling-sharpening were identified. Correlations between cognitive style dimensions and achievements in different school subjects were significant. Naiman et al. (1978) also found field-independence to be significantly correlated with achievements in foreign language (French), which was not the case with interference and breadth of categorization.

Zampogna et al. (1976) studied the relationship between student learning style and traditionally structured or individualized foreign language instruction. All students experienced both environments. Learning style was measured by means of Hunt's PCM (see next ch.). In addition to that students also answered a Learning Environment Questionnaire. The results showed that students with high conceptual-level scores expressed a preference and need for individualized environment while students with low conceptual-level scores expressed a preference and need for traditional environment.

Lepke (1977) reports of a study in which Hill's Cognitive Preference Inventory was used to determine university students' learning style. The learners were then enrolled in either a teacher-centered or an individualized program. Achievers and non-achievers in either group were compared. The purpose was to study the relationship between the learner's level of achievement and the compatibility of his cognitive style with the particular mode of instruction to which he was exposed. Achievers in the traditional group had visual and auditory sense modality, orientation towards authority figure and teacher-centered setting and ability to establish daily goals and complete the assigned tasks for themselves. Achievers in the individualized group were either peer-oriented or independent, which was the major difference with the other group. Non-achievers in the traditional group were very sensitive to the feelings of others, while non-achievers in the individualized group had orientation towards authority figure, tendency to communicate positively with others, preference for visual stimuli and orientation towards sound. Lepke concludes that there is a significant and demonstrable relationship between learning styles and foreign language achievement.

Harper (1977) asked students of French in a Junior College to describe their own perceptions of the learning style they preferred. Based on these descriptions the students were given appropriate learning opportunities. Achievement levels were reported to show significantly higher performance scores for students who studied the way they preferred than for control group.

Research that has, as yet, been done of learning styles and strategies is rather limited and spotty. The whole field is very heterogeneous in every respect. The above review shows that it is difficult to make generalizations as to what kind of person/environment match produces the best results in learning different school subjects. It will, however, provide some guidance as to what styles to choose.

3.3 Problem Areas and Instruments

As is evident from the foregoing there are numerous ways which could be used in specifying component P₁ in terms of the styles. Consequently the problem areas of the pilot study concern the choice of the styles and the try-out of the instruments used for measuring them. The general problem at this stage is what styles could serve as potential accessibility characteristics. CL is so far almost the only one which has an empirically well-established position as such. In this case the purpose is to see how the instrument developed in another cultural setting works in ours. One of the problems is also to find out how to measure styles for which there are no ready instruments available. At this stage we only speak of styles since it was not possible to include learning situations into the pilot study. Rough background information will, however, be provided by grades assigned by teachers, which will be used as guides of the educational relevance of particular styles in a Finnish setting.

Conceptual Level is measured by means of PCM(=Paragraph Completion Method) developed by Hunt et al. (1978). The instrument is a semi-projective one consisting of the following six topics:

1. What I think about rules ...
2. When I am criticized ...
3. What I think about parents ...
4. When someone does not agree with me ...
5. When I am told what to do ...

Students are asked to write at least three sentences on each topic within the time limit of three minutes per stem. The responses are regarded as thought samples to be scored according to how a pupil thinks. The scale ranges from 0 (predependent, egocentric, impulsive orientation) to 3 (interdependent, empathetic, cognitively complex orientation). The total CL score is the mean of the three highest responses, which is based on the idea that a pupil's low score on some topic may be due to temporary lack of interest. It is not considered necessary for a pupil to have to demonstrate a high level of conceptual thinking on each response. It is enough to do so a few times. Besides it is considered almost

impossible to fake high scores on this test. (For more information on administration and scoring see the manual.)

The themes and scoring instructions were translated into Finnish by A.Puurula, M.A. The translation of the themes was somewhat problematic: exact word for word translation, even if it were possible, may not carry the same idea as the original title does to the native speaker, a fact that has to be accepted. As was mentioned in ch.2.1.4 the analysis of the pupil's use of his native language is considered an important source of information on learning styles. PCM naturally relies on that too, but it is basically different since it requires looking beyond the mere content of the pupil's answers. The center of interest is in how he thinks, the structure of his response.

Of the other styles field-independence/field dependence was selected because of its firm research basis and educational relevance (see e.g. Witkin et al.1977). It is measured by means of GEFT (=Group Embedded Figures Test; Witkin et al.1971). Copyright for the use of the test was received (20 June 1980) and it was translated into Finnish by the present writer. The GEFT is a paper-and-pencil test which requires the pupil to find and trace the outlines of eight simple geometric forms hidden within 25 progressively more complex figures. The test consists of three sections. The score is the total number of simple forms correctly traced in the second and third sections. There is a time limit of five minutes for each of these sections. The purpose of the first section (time limit: two minutes) is only to make sure that the subjects have understood the instructions. These items are not included in the total score. A high score on the test indicates an analytic and a low score a global or non-analytic style of perceiving and processing information. According to the manual consistently high validity and reliability scores have been obtained. (For more information see the manual.)

A questionnaire was also developed for some of the styles which do not have a standard measuring instrument available or if they do the instrument is far too complicated and time-consuming to be

used like the one developed by Dunn et al. (1978). The questionnaire developed for this study is based on the theoretical framework, previous studies and instruments. Pupils have to indicate on a five-point scale the degree of their agreement with statements concerning their learning styles. The areas contained are sensory modality preferences, preference for structure, motivational and sociological elements. Of all the modalities the three most important ones were selected: kinesthetic, visual and auditory (sample items: "The things I remember best are things I have written", "The things I remember best are things I have read", "The things I remember best are things I have been told"). Questions concerning preference for structure were included to see to what extent the pupil's need for structure as indicated by PCM would correspond to what they preferred (sample items: "I would like to do things in my own way", "I like to be told exactly what to do"). Motivational element is important since there is evidence to show that internally and externally motivated students need different kinds of feedback (Hunt 1971). There is additional evidence according to which field-independent are likely to learn more under conditions intrinsic motivation and criticism has greater impact on the learning of field-dependent people (Witkin 1976,62). (sample items: "I want to get good grades because my parents want it", "I am happy if I do well at school".) The sociological element was included to get a rough estimate of how pupils think they learn socially (sample items: "I learn best when I work alone", "I learn best when I work with some friends of mine".)

Considering the number of styles that could have been used the above is restricted. Trying out more ways of specifying P would, however, have been far beyond the resources available for the study.

3.4 Results

The subjects of the study ($N=107$) are from two different eighth grades of two different comprehensive schools in Kerava, an urban district about thirty kilometers from Helsinki. The average age of the pupils in the eighth grade is fourteen. The schools in question were chosen because they were easily available and within easy reach.

The PCM was administered by A. Puurula (who also administered the later tests) in December 1979. The original intention was to administer GEFT and the learning style questionnaire to the same sample during the spring term of 1980. Many other duties of the present writer made, however, carrying out the original plan impossible and the rest of the data was not gathered until the beginning (September) of the autumn term 1980, which was rather unfortunate for two reasons. First of all, on account of a new system of organizing the classes, the pupils of the original sample had been placed into new classes so that finding them was rather difficult and administering the tests to the original sample meant also administering them to their new classmates. Thus the number of the pupils who took GEFT and the questionnaire is 194. The results of the original sample (who took PCM) will only be reported here. Some of the pupils of the original sample could not be met; they had either moved away or were absent on the day of testing. The size of the sample in the second testing is consequently 93. Secondly there is a time lapse of about nine months the impact of which on the styles cannot be estimated. On the other hand, cognitive styles are considered rather permanent.

The grades that will be used as background information are those assigned by teachers at the end of the spring term (May 1980). These include English (foreign language), mathematics, written language skills in native language (Finnish) and history. Foreign language and mathematics were chosen because they differ from most of the other school subjects by being highly cumulative in nature,

native language because it is the most important for the pupil's development and history because it is a subject which everyone has in common at that level.

The PCM was scored by A. Puurula and another scorer trained by her. The inter-rater reliability was .93 (N=107). The correlation coefficients between the two coders were also computed separately for each of the four classes participating in testing. The coefficients were as follows: .96 (N=25), .92 (N=28), .96 (N=28) and .90 (N=26). The values received in this study compare well with those in the manual. As for the construct validity of the test the reader is referred, in addition to the manual, also to Hunt (1971, 1975).

The reliability of GEFT was estimated by computing the correlation coefficient between the two parallel sections with identical speed limits and correcting it by means of Spearman-Brown prophecy formula. The value received was .86 (N=93). It also compares well with the values given in the test manual, though the group version of the test is rather recent and much information about it has not been accumulated yet. For ways of validating this type of instrument see the manual and other relevant literature (e.g. Witkin 1975).

The parallel forms of the learning style questionnaire were also used in estimating the reliability. The value received after correction was .61, which can be considered satisfactory at the most. The teachers of the classes pointed out that there are pupils who have difficulties in reading and understanding written text. These cases naturally lower the reliability of the questionnaire. Getting any empirical information about the validity of the questionnaire is at this stage impossible. The content validity could, however, be considered at least satisfactory since the questionnaire contains the areas that are most frequently encountered in educationally relevant literature. The correlations between the items within each of the four areas were computed. Based on this information some items were combined, others used as such and two discarded. All the variables and their means and standard deviations are given

in Table 1 (Appendix 1). The problems connected with teacher-assigned grades will not be dealt with here. Their use is considered acceptable since they serve as rough indicators of the educational relevance of the style variables. Finally it is to be pointed out that we have a kind of streaming system in foreign languages and mathematics in the upper grades of our comprehensive school. It means that pupils can choose between three different streams. C-stream is considered to consist only of the so-called basic things, while A-stream is more varied as to the objectives and contents. B-stream falls in between these two. The system has aroused a lot of heated discussion and it will (obviously) be abolished in a couple of years' time.

The correlations between the variables were computed. One of the main points of interest was the relationship between Conceptual Level and field-independence/field-dependence, the two well-established cognitive styles. The correlation between the two tests was .18 in our sample. The low correlation is no wonder since PCM represents a much wider area of personality than GEFT, which is a test of visual information processing and perception. The correlations between these two tests and grades assigned by teachers are given in Table 2 (Appendix 1). Of all the other correlations only those that are significant are documented in Table 3 (Appendix 2).

CL is an indicator of the students' requirement of structure. In our Finnish sample the percent of students requiring differing degrees of structure is as follows:

Grade (average age 14)	N	Much .5-1.0	Some 1.2-1.4	Less 1.5-1.9	Little 2.0+
8	93	28	29	30	13

The figures above are not very much different from the norms given in the manual (Hunt et al. 1978,40). It is to be noted that of all the students requiring much or some structure 55 percent expressed a preference for high structure while only 8 percent preferred low structure. The rest were uncertain. In the same way the majority (50 percent) of those requiring less or little

expressed a preference for high structure while 7 percent preferred less structure and 27 percent were uncertain. Thus this group seemed to prefer more structure to less as indicated by the questionnaire (concerning which there are some limitations, p 26).

In order to get more specific information than that yielded by correlation coefficients extreme groups of the style variables were compared. The high CL group consists of students with the minimum score of 1.83 and the low CL group of those with the maximum score of 1.00. The forming of the low CL group follows the norms given in the manual, which is not the case with the high CL group. Had the limit of 2.00 been followed there would only have been thirteen students in the group. Only the cases with significant differences between the groups are reported (Table 4, Appendix 2). Comparing the two groups with regard to mathematics and English would not have been very purposeful on account of the small numbers caused by the streaming system. The numbers are given in Table 5, which shows that in English there is a clear division between the two groups with the majority of high CL students taking A-stream and the majority of the low CL group taking B-stream. The case is different in mathematics with the majority of the low CL group taking also A-stream. There was no difference between the grades of mathematics in A-stream.

The high GEFT group consists of students with the minimum score of 15 and the low group of those with the maximum score of 7. In forming these groups the norms given in the manual were not used since they are based on college students and computed separately for men and women. In this group the scores of boys and girls were not significantly different as they were in the case of CL (Table 6, Appendix 3). The cases with significant differences between the two groups are reported in Table 7 (Appendix 3). As regards English and mathematics most of the high GEFT group have taken A-stream and most of the low group B-stream (Table 6).

The other style variables were also used to form extreme groups. These comparisons did not, however, yield much information.

4. Discussion

The study showed the educational relevance of PCM and GEFT in the Finnish setting. The Finnish version of PCM proved to be a reliably scorable instrument. The results were to a great extent similar to those obtained in Canada with regard to the distribution of CL scores in the age group in question, the difference between boys and girls and relationship with school achievements as indicated in this study by teacher-assigned grades. The relationship with mathematics was, however, less obvious as regards the streaming system. CL did not differentiate between the streams: the majority of the low CL group had also chosen A-stream.

Field-independence/field-dependence as measured by GEFT was also related to school achievements with the exception of foreign language (English), with which the correlation was not significant. One reason for this may be the fact that the grades assigned by teachers are rather global in nature. Objectives, contents and activities used in the teaching of different school subjects are rather varied in nature. This is particularly true of the foreign language. More specific information would be needed. Naiman et al. (1979) have, for example, found that the test correlates significantly with French listening comprehension and imitation tasks. The analytic style is often hypothesized to promote language learning and the correlational information might be considered to support this view. On the other hand, there is, however, research evidence to show that field-dependent people are more emphatic, more responsive to facial expressions of other people, attentive to human content in the environment and superior in remembering verbal messages that are more social in content (Witkin 1976). All these could be thought to promote the communication skills of the foreign language. Brown (in Schuman 1978) believes that field-independence is more important in formal language learning situations and field-dependence in informal ones where learning is indicated by the ability to

communicate effectively with native speakers. This view seems reasonable enough but would require empirical studies.

One more question concerning field-independence/field-dependence is the fact that it was measured by a purely visual test. This kind of test could be thought to be more closely related to the literary skills of the foreign language, that is, reading comprehension and written production, in which the field-dependent person might be more easily distracted by cues that are spatially close to each other in the text but not relevant from the point-of-view of the whole discourse. Auditory tests of this style might be more relevant for listening and speaking skills.

GEFT differentiated, however, between the choice of the stream in the foreign language, too, the majority of the high group having chosen A-stream and that of the low group B-stream, which was also the case in mathematics. An interesting thing was that the low GEFT group expressed a greater preference for structure than did the high GEFT group.

As to the other style variables based on the questionnaire the results were rather insignificant. The reliability of the questionnaire was not very high, students with reading disabilities had difficulties with it, which may have given rise to response set. As regards the sensory channels most of the pupils expressed preference for visual modality, which is natural since the main channel used in the exchange of information in present-day culture is visual. It could be assumed that a number of those with learning difficulties might be more auditorily minded. This is something that will be further investigated in the spring term 1981, when pupils from this sample are selected for case studies with individual interviews and small learning tasks to be performed.

Another line of research will start as sketched in chapter 2.1 in different school subjects. It is to be hoped that the results

of the factor-analytic study of all cognitive styles will soon be available since they may influence the direction of our studies and the choice of the variables.

An interesting question concerning learning styles is whether students have the same styles in different subjects and what is the impact of the variation in the structure of the subjects themselves (see Hunt 1979). These two questions should be investigated empirically. As far as the latter in particular is concerned it seems to us that teachers give attention to the variation of the structure of the subjects in planning their instruction. They have to decide whether to place greater emphasis on contemporaneous matching, the purpose of which is the facilitation of immediate learning, or developmental matching, the purpose of which to enhance the pupil's growth towards greater personal growth and interpersonal maturity. The writer's personal view is that in subjects in which gaps in previous learning make present learning difficult or impossible, that is, in subjects the learning of which is highly cumulative in nature, greater emphasis should be placed on the facilitation of immediate learning (particularly with those students who have special learning difficulties). This would concretely mean, for example, less use of group-work in some subjects than in others. The reason for this view is that the long-term effects of constant failure in learning may be very harmful for the development of the whole personality of the pupil. In spite of the seeming conflict there does not necessarily have to be one if the teachers can co-operate effectively.

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Table 1. Means and standard deviations of variables
(N=93, unless indicated otherwise)

	$\bar{x}$	s	
Conceptual Level	1.36	0.51	
Embedded Figures	10.83	4.56	
Sensory Channels:			
Kinesthetic	7.53	1.49	
Visual	3.62	0.82	
Auditory	7.02	1.42	
Preference for:			
High Structure	6.61	1.97	
Low Structure	7.94	1.74	
Motivation:			
Internal	12.51	1.54	
External	7.08	1.64	
Lack of Motivation	6.82	1.58	
Sociological element:			
Learns Best Alone	3.56	1.14	
Learns Best with a Peer	3.03	0.99	
Teacher Assigned Grades:			
History	7.22	1.42	
Native Language	7.47	1.30	
English:			
A-stream	8.14	1.24	N=34
B-stream	6.67	1.29	N=48
C-stream	6.54	0.65	N=11
Mathematics:			
A-stream	7.42	1.16	N=49
B-stream	6.21	1.30	N=39
C-stream	6.80	0.40	N=5

Table 2. Correlation coefficients between PCM, GEFT and
teacher-assigned grades

	CL	N	GEFT	N
Native Language	.43 ^x	107	.35 ^x	93
History	.38 ^x	107	.27 ^x	93
English:				
A-stream	.59 ^x	41	.05	34
B-stream	.09	52	-.15	48
C-stream	.54 ^x	14	.21	11
Mathematics:				
A-stream	.25	56	.33 ^x	49
B-stream	.13	44	.13	39
C-stream	(-.02	7	-.21	5)

Table 3. Significant correlations between learning style questionnaire variables and the others

	CL	GEFT	Native language	Hist. B-str.	Mathematics A-str.	B-str.
Visual channel		-.22		.28		
Preference for low str.			.28			
Internal motivation			.23		.30	.50
External motivation	-.21			-.31		
Lack of motivation				-.34		
Learns Best Alone			.23			
Learns Best with a Peer				-.20		

Table 4. Means and standard deviations of teacher-assigned grades of high and low CL-groups

		High CL (N=27)	Low CL (N=31)	t
Native Language	$\bar{x}$	8.07	6.77	4.05 ^{xxx}
	s	1.27	1.12	
History	$\bar{x}$	7.92	6.65	3.56 ^{xxx}
	s	1.53	1.12	

Table 5. The number of pupils in different streams of high and low CL and GEFT groups

	High CL	Low CL	High GEFT	Low GEFT
English:				
A-stream	17	8	20	3
B-stream	8	18	3	10
C-stream	2	5		6
Mathematics:				
A-stream	21	14	21	4
B-stream	5	13	2	12
C-stream	1	4		3

Table 6. Means and standard deviations of style variables of boys and girls

	Boys (N=50)		Girls (N=43)	t
CL	$\bar{x}$	1.15	1.64	4.82 ^{xxx}
	s	0.43	0.52	
GEFT	$\bar{x}$	11.16	10.34	-0.84
	s	4.30	4.85	

Table 7. Means and standard deviations of teacher-assigned grades and style variables of high and low GEFT-groups

	High GEFT (N=23)		Low GEFT (N=19)	t
Native Language	$\bar{x}$	8.39	6.89	4.11 ^{xxx}
	s	1.01	1.29	
History	$\bar{x}$	8.21	6.84	3.20 ^{xx}
	s	1.41	1.26	
CL	$\bar{x}$	1.57	1.23	2.19 ^x
	s	0.69	0.26	
Preference for High Structure	$\bar{x}$	5.95	7.21	-2.06 ^x
	s	2.19	1.64	

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